

We claim:

Sub B1
1. A combinatorial chemical synthesis reaction tool,
comprising:

a reaction vessel,

5 a reaction vessel support disposed to hold the reaction
vessels in a preferred orientation,

an injection port, including a pressure seal, situated to
provide access to said reaction vessel for the injection of
liquids into said reaction vessel,

10 an evacuation port, including a pressure seal, situated to
provide access to said reaction vessel for the evacuation of
fluids from said reaction vessel, and

injection and evacuation fittings formed to matingly engage
said respective injection and evacuation ports and to thereby
15 enable the delivery of fluids to the reaction vessel and the
evacuation of fluids from said reaction vessel.

2. The reaction tool of claim 1, wherein said injection
port is located at the top of said reaction vessel.

20

3. The reaction tool of claim 2, wherein said evacuation
port is located at the top of said reaction vessel.

4. The reaction tool of claim 2, wherein said evacuation
25 port is located at the bottom of said reaction vessel.

5. The reaction tool of claim 1, further comprising:
a supplying vessel, and flexible tubing connected directly
from said injection fitting to said supplying vessel.

30

6. The reaction tool of claim 5, further comprising:
a receiving vessel, and
flexible tubing connected directly from said evacuation
fitting to said receiving vessel.

35

08872097 051097
460190 46024880

7. The reaction tool of claim 1, wherein said evacuation port is a spring-loaded port.

8. The reaction tool of claim 1, wherein said reaction vessel support comprises:
top and bottom vessel support plates with tapered injection through fittings.

9. The reaction tool of claim 8 further comprising an actuator to selectively control movement of the top and bottom vessel support plates.

10. The reaction tool of claim 8 wherein the top and bottom support plates form a carousel and the tapered injection through fittings are formed in a ring around the periphery of said top carousel vessel support plate and tapered evacuation fittings formed in a matching ring around the periphery of said bottom vessel support carousel plate.

11. The reaction tool of claim 10, further comprising:
a top carousel fitting plate with fittings arranged in a ring around the periphery of said top carousel fitting plate to match the tapered injection through fittings of said top carousel vessel support plate.

12. The reaction tool of claim 11, further comprising:
a bottom carousel fitting plate with fittings arranged in a ring around the periphery of said bottom carousel fitting plate to match the tapered evacuating through fittings of said bottom carousel vessel support plate.

13. The reaction tool of claim 12, wherein said top and bottom carousel fitting plates close to simultaneously engage the injection fittings of said carousel top fitting plate with the tapered injection through fittings of said top carousel

08872097.061097
260150 26022880

all male
C
all male

vessel support plate and to simultaneously engage the evacuating fittings of said bottom carousel fitting plate with the tapered through fittings of said bottom carousel vessel support plate.

5 14. The reaction tool of claim 13, wherein said vessel support carousel is connected to rotate under control of a motor to thereby align fittings and through fittings in a desired manner when said fitting plates are disengaged.

10 15. The reaction tool of claim 14, wherein said vessel support carousel is reciprocally moved to agitate the reaction vessel.

15 16. The reaction tool of claim 13, wherein the top and bottom carousel plates can be selectively moved to agitate the reaction vessel.

20 17. The reaction tool of claim 1, further comprising:
a stirring motor with a magnet attached to its shaft, said magnet positioned adjacent a sidewall of said reaction vessel;
and

a stirring bar located within said reaction vessel, said stirring bar tending to follow the rotation of said magnet.

25 18. The reaction tool of claim 1, further comprising:
electromagnetic coils mounted around the outside of said reaction vessel, and
a tapered whisk stirrer located within said reaction vessel, said stirrer being responsive to varying magnetic fields
30 produced by said push-pull coils by rotating within said reaction vessel, thereby stirring the contents of said vessel.

35 19. The reaction tool of claim 1, further comprising:
electromagnetic push-pull coils mounted adjacent the outside of said reaction vessel, and

08872097.061097

a floating stirrer located within said reaction vessel said stirrer being responsive to varying magnetic fields produced by said push-pull coils by rotating within said reaction vessel, thereby stirring the contents of said vessel.

5

20. The reaction tool of claim 1, further comprising:
a resistive heater which snaps on to the exterior of said reaction vessel.

10 21. The reaction tool of claim 20, wherein said resistive heater includes means for selective on-line control.

22. The reaction tool of claim 1, further comprising a U-valve formed of flexible tubing and connected to regulate the
15 flow of liquids from said evacuation through fitting.

Sub B2>
23. A universal fluid exchanger comprising:
a reaction vessel;
a reaction vessel support disposed to hold the reaction
20 vessels in a preferred orientation;
an injection port, including a pressure seal, situated to provide access to said reaction vessel for the injection of liquids into said reaction vessel;
an evacuation port, including a pressure seal, situated to
25 provide access to said reaction vessel for the evacuation of fluids from said reaction vessel;
injection and evacuation fittings formed to matingly engage said respective injection and evacuation ports and to thereby enable the delivery of fluids to the reaction vessel and the
30 evacuation of fluids from said reaction vessel; and
an actuator for controlling selectively aligning the injection and evacuation ports and the injection and evacuation fittings, respectively.

35

08872097.061097

24. The fluid exchanger of claim 23, wherein said injection port is located at the top of said reaction vessel.

25. The fluid exchanger claim 24, wherein said evacuation port is located at the top of said reaction vessel.

26. The fluid exchanger of claim 24, wherein said evacuation port is located at the bottom of said reaction vessel.

27. The fluid exchanger of claim 23, further comprising: a supplying vessel; and flexible tubing connected directly from said injection fitting to said supplying vessel.

28. The fluid exchanger of claim 23, further comprising: a receiving vessel; and flexible tubing connected directly from evacuation fitting to said receiving vessel.

29. The fluid exchanger of claim 23, wherein said evacuation post is a spring-loaded port.

30. The fluid exchanger of claim 23, wherein said reaction vessel support further comprises:

top and bottom carousel vessel support plates with tapered injection through fittings formed in a ring around the periphery of said top carousel vessel support plate and tapered evacuation fittings formed in a matching ring around the periphery of said bottom vessel support carousel plate.

31. The fluid exchanger of claim 30, further comprising: a top carousel fitting plate with fittings arranged in a ring around the periphery of said top carousel fitting plate to match the tapered injection through fittings of said top

08872097.061097

carousel vessel support plate.

32. The fluid exchanger of claim 31, further comprising:
a bottom carousel fitting plate with fittings arranged in a
5 ring around the periphery of said bottom carousel fitting plate
to match the tapered evacuating through fittings of said bottom
carousel vessel support plate.

33. The fluid exchanger of claim 32, wherein said top and
10 bottom carousel fitting plates close to simultaneously engage
the injection fittings of said carousel top fitting plate with
the tapered injection through fittings of said top carousel
vessel support plate and to simultaneously engage the evacuation
fittings of said bottom carousel fitting plate with the tapered
15 through fittings of said bottom carousel vessel support plate.

34. The fluid exchanger of claim 33, wherein said actuator
is connected to said vessel support carousel causes it to rotate
under control of a motor to thereby align fittings and through
20 fittings in a desired manner when said fitting plates are
disengaged.

35. The fluid exchanger of claim 23, further comprising:
a stirring motor with a magnet attached to its shaft, said
25 magnet positioned at the sidewall of said reaction vessel; and
a stirring bar located within said reaction vessel, said
stirring bar being responsive to the rotation of said magnet by
similarly rotating.

30 36. The fluid exchanger of claim 23, further comprising:
electromagnetic coils mounted to the exterior of said
reaction vessel; and
a tapered whisk stirrer located within said reaction
vessel, said stirrer being responsive to varying magnetic fields
35 produced by said coils by rotating within said reaction vessel,

08872097.061097

thereby stirring the contents of said vessel.

37. The fluid exchanger of claim 23, further comprising:
electromagnetic coils mounted to the exterior of said
5 reaction vessel; and

a floating stirrer located within said reaction vessel said
stirrer being responsive to varying magnetic fields produced by
said coils by rotating within said reaction vessel, thereby
stirring the contents of said vessel.

10

38. The fluid exchanger of claim 23, further comprising:
a resistive heater which snaps on to the exterior of said
reaction vessel.

15

39. The fluid exchanger of claim 38, wherein said
resistive heater includes a controller for on-line control.

20

40. The fluid exchanger claim 23, further comprising a U-
valve formed of flexible tubing and connected to regulate the
flow of liquids from said evacuating through fitting.

25

41. The fluid exchanger of claim 34, wherein said
supplying vessels are connected to supply reagents and solvents
for use in combinatorial chemical synthesis.

30

42. The fluid exchanger of claim 41, wherein the actuator
further comprises a carousel rotation motor connected to rotate
said vessel support carousel; and said fluid exchanger further
comprises:

a resistive heater which snaps on to the exterior of said
reaction vessel,

a stirring motor with a magnet attached to its shaft, said
magnet positioned at the sidewall of said reaction vessel; and

a controller connected to control said carousel rotation
35 motor, said resistive heater and said stirring motor.

08872097.061097

43. The fluid exchanger of claim 42, further comprising:
a plurality of reaction vessels, each having a resistive
heater snapped on to its exterior; and

a plurality of stirring motors positioned at the sidewalls
5 of said reaction vessels, with each resistive heater and each
stirring motor connected for stored program control by said
controller.

44. A method for automatically exchanging fluids within
10 one or more reaction vessels held in a vessel support structure,
comprising the steps of:

a) positioning a reaction vessel to receive reactant from
an injection fitting;

b) engaging the reaction vessel with the injection
15 fitting;

c) determining whether all the desired reactants are
contained within all the appropriate reaction vessels;

d) disengaging the injection fittings and returning to
step a) if more reactants are desired;

20 e) if the determination is made in step c) that no more
reactants are required, determining whether the reactants are at
a desired temperature;

f) heating reactants which require heating and returning
to step e); and

25 g) stirring reactants within reaction vessels.

45. The method of claim 44, further comprising the steps
of:

h) determining whether more reactants are required for any
30 of the reaction vessels and proceeding to step d) if more
reactants are required;

i) aligning reaction vessels with evacuation fittings if
no further reactants are required; and

j) engaging evacuation fittings with reaction vessels and
35 evacuating contents from a reaction vessel.

08872097.061097

46. An integral heater and stirrer for clip on attachment to a reaction vessel comprising:

a clip;

a mounting platform having a port, said mounting platform
5 attached to the clip;

a temperature coefficient of resistance heater pad attached to the clip;

a stirring motor having a shaft with a magnet at its end;
and

10 a bushing whereby the stirring motor is mounted through the bushing so that when the integral heater and stirrer is clipped to the reaction vessel, the magnet is properly spaced with respect to a sidewall of the reaction vessel and the clip supports both said heater pad and said stirring motor.

15

08872097-061097